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ANNUAL REPORT
1989

AF LOGISTICS COMMAND

DIRECTORATE
OF
MANAGEMENT SCIENCES
AFLC/XPS

WPAFB, OHIO 45433

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FOREWORD

The Directorate of Management Sciences (XPS) conducts and sponsors studies and research of significant logistics issues.

Our focus is on the development, modification, and application of mathematical models which can help relate logistics resource alternatives to the peacetime readiness and wartime sustainability of AFLC's customers--the operating commands.

This is our sixth Annual Report. It includes descriptions of the projects we worked on in 1989 and our plan for 1990. If you have any comments, or suggestions for further research, contact us at AV 787-3201 or commercial (513) 257-3201.

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EXECUTIVE SUMMARY

The Directorate of Management Sciences (AFLC/XPS) is comprised of three Divisions: the Assessment Applications Division (XPSA), the Concept Development Division (XPSC), and the Consultant Services Division (XPSM). We conduct and sponsor studies and research of significant logistics issues. We use, modify, and develop new or improved methods, models, and tools to manage logistics resources.

Our goal is to quantify the relationships between alternative logistics resources and resultant aircraft availability and sustainability so that AFLC can prioritize and justify its investments in those resources. We work toward this goal by performing studies for customers in the headquarters and by pursuing a few internally developed projects which have significant potential for providing valuable insights into these relationships.

In 1989 we focused on four major areas--Distribution and Repair In Variable Environments (DRIVE), Weapon System Management Information System (WSMIS) enhancements, Engine Pipeline Studies, and the cost and responsiveness implications of a number of specific alternatives designed to reduce logistics costs. In 1990 we plan to implement the quarterly DRIVE algorithm, continue our enhancements of WSMIS in the Strategic Airlift area, complete our Engine Pipeline Studies, and expand our investigation of alternatives designed to reduce logistics costs.

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I. THE DIRECTORATE OF MANAGEMENT SCIENCES

The function of the Directorate of Management Sciences (AFLC/XPS) is to provide a source of operations research skills for the Headquarters. Although we are a part of the DCS, Plans and Programs, we often perform our studies and analyses for clients in other DCSs and two of the Centers located at the Headquarters: the Logistics Operations Center (LOC) and the Logistics Management Systems Center (LMSC). In addition, we sponsor a limited amount of contract research through the Management Sciences Contract Studies Program.

The Directorate includes three Divisions: the Assessment Applications Division (XPSA), the Concept Development Division (XPSC), and the Consultant Services Division (XPSM). The majority of our twenty analysts have advanced degrees in technical areas such as operations research, mathematics, engineering, and management sciences. Each new analyst is expected to have, or obtain within a three to four year training period, an appropriate advanced degree.

Our emphasis has been, and will continue to be, on the application of mathematical modeling techniques to improve the management of logistics resources. Our objective is to identify specific actions which AFLC can take to provide the most substantial impact in terms of increasing combat capability (readiness and sustainability), or decreasing costs, or both. We have focused our efforts on the development and enhancement of mathematical models which can relate logistics resource decisions to resultant impacts on aircraft availability.

The traditional role of operations research organizations places them outside the normal decision making lines of authority. Such an organizational structure promotes objective and unbiased analyses since the analysts are not in an advocacy role, promoting a particular program or concept. We in the Directorate of Management Sciences have been fortunate in that we are, for the most part, "off line" and able to conduct our analyses in what we believe is the proper environment.

The Directorate works closely, and shares results, with other governmental and private analysis organizations such as the Air Force Institute of Technology, the Air Force Logistics Management Center, the Air Force Human Resources Laboratory, the RAND Corporation, and the Logistics Management Institute.

The next three sections of this report contain specifics, by Division, of our 1989 accomplishments and our program for 1990.

II. THE ASSESSMENT APPLICATIONS DIVISION

A. INTRODUCTION

The Assessment Applications Division, XPSA, is focusing on issues related to (1) recoverable item spares requirements computations for achieving combat capability objectives during a wartime surge period, (2) weapon system capability due to recoverable item spares support policies and inventory status, and (3) prioritization of repair and distribution actions to utilize repair resources and available spares to achieve the best possible weapon system readiness in peacetime and sustainability in war. All of our efforts directly relate to these three areas.

We are the Air Force technical OPR for the Dyna-METRIC model, which is the heart of the Sustainability Assessment Module (SAM) of the Weapon System Management Information System (WSMIS). Dyna-METRIC is used for both wartime capability assessment and wartime spares requirements computation. Dyna-METRIC is now the official Air Force model for wartime supply support capability assessment and for wartime surge recoverable spares requirements computation. We work closely with WSMIS developers and users as well as other Dyna-METRIC users throughout the Air Force and in other agencies to ensure a continuing ability to use the model in a valid and responsible manner.

We are also the technical OPR for the Distribution and Repair In Variable Environments (DRIVE) model. This model has been operating for the past three years in a prototype mode at Ogden ALC, for items repaired in three F-16 avionics repair shops, to prioritize repair and distribute serviceables based upon the marginal gain in operational capability. Our past efforts were directed toward formulating the concept, defining the requirements, resolving system issues, and developing a strategy for the implementation of DRIVE. In 1989 we worked hard to develop the production version of DRIVE and provide the principal technical leadership and support for the development of DRIVE.

The Division staff includes six operations research analysts, a logistics staff officer, a computer assistant, and a junior fellowship student. All of our efforts focus on improving the policies and technical methodology for supporting the achievement of the greatest possible combat capability at affordable costs in logistics resources. We actively guide the AFLC staff and other Air Force agencies in incorporating these methodologies in their management of logistics resources.

B. ACCOMPLISHMENTS IN 1989

Our plan for 1989 focused on two areas of overriding importance: to design the production DRIVE system to enable AFLC to provide substantially greater support to the combat commands by making depot maintenance and distribution actions more responsive to near-term sortie generation requirements; and to continue to enhance the ability of AFLC's Weapon System Management Information System

(WSMIS) to project the number of aircraft available to generate sorties or desired utilization rates during war.

Our primary focus in our DRIVE support was on the development and implementation of the production DRIVE system. We developed and delivered the production version of the model and provided the principal technical guidance to the Functional Integration Office and WSMIS SPO for the system design. We chaired the DRIVE Design Working Group, developed the specific data input and output format specifications, and analyzed data inputs and model outputs to help pinpoint system design deficiencies. We continued to support the DRIVE prototype effort at OO-ALC and found it invaluable for 'lessons learned' both for model modifications and for insight into design and policy issues. We supported discussions with all MAJCOMs to explain DRIVE and examine their unique needs. We began work on extensions to DRIVE, foremost of which was a joint effort with the TAF to test the use of DRIVE to guide asset redistributions to correct maldistributions across bases. We also provided unplanned support to examine how DRIVE could help prioritize repair and distribution in a pilot effort to examine the implications of moving intermediate maintenance from base to depot level. We made substantial progress in all our endeavors and continued to identify significant policy and procedural changes that should result in substantial improvements in our logistics support to operational forces for the dollars expended.

Our support of WSMIS has continued to yield significant improvements in capability assessment and wartime spares computation processes. We set the standards for generating spares-constrained capability assessments beyond 30 days of war and made substantial progress in identifying ways to improve the assessments of units with small numbers of aircraft. In our continued role as the Air Force Technical OPR for the Dyna-METRIC model, we made significant improvements in its usefulness and its ability to efficiently handle large data files. We played a key role in modifying WSMIS to compute war readiness spares kits for both Tactical and Strategic Airlift aircraft.

B.1. Distribution and Repair in Variable Environments (DRIVE)

B.1.a. **TITLE:** Implementation of DRIVE

CUSTOMER: USAF/LE, AFLC/MM/MA/DS/PM/XP, ALC/MM/MA/DS/PM, MAJCOMs

OBJECTIVE: Continue support of the implementation of DRIVE, a repair and asset allocation prioritization algorithm, within the framework of the AFLC data system structure.

RESULTS: Our primary focus during 1989 was to support the implementation of DRIVE. In our capacity as the Air Force technical OPR for the DRIVE model, we:

(1) Designed the production model and developed the software. We also accomplished analysis efforts to support model development.

Project B.1.b, DRIVE Model Development and Testing, provides further details.

(2) Provided technical guidance to the DRIVE Functional Integration Office (DFIO), AFLC/MMISD, in evaluating contractor proposals, assessing needed analysis efforts and determining recommended policy and procedural impacts and solutions. Project B.1.c., DRIVE Studies, describes some of our efforts.

(3) Provided guidance to the contractors' design and development efforts and evaluated the progress and adequacy of those efforts. An important part of our work was to chair the DRIVE Design Working Group. The Working Group sessions provided the forum for system design decisions such as data sources, data formats, interface requirements, and resolution of technical issues.

(4) Developed the specific data format specifications for both development contractors to use for providing data to the production DRIVE model and for receiving data from the model to use in producing output products for users.

(5) Supported system development by analyzing data inputs and model outputs to help pinpoint system design deficiencies. These deficiencies were either identified to the WSMIS SPO for corrective action or pursued through the DRIVE Design Working Group. In many cases, we worked with the development contractors to provide guidance to determine specific alternatives.

(6) Supported the DRIVE Functional Integration Office in visits to all MAJCOMs to explain DRIVE, how it will impact them, how they need to provide information on their operational requirements, and what unique needs they may have.

(7) Continued to support the DRIVE prototype at OO-ALC and use it as a field laboratory for model development. We used 'lessons learned' from the OO-ALC prototype both for model modifications and for insight into design and policy issues.

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B.1.b. **TITLE:** DRIVE Model Development and Testing

CUSTOMER: AFLC/MMI/XPS, LMSC/SMW

OBJECTIVE: Develop the production DRIVE model and provide the software to the WSMIS SPO.

RESULTS: We developed the production DRIVE model and provided the software to the WSMIS SPO for incorporation into the DRIVE production system. Specifically we:

(1) Rehosted the DRIVE model from the OO-ALC prototype environment to the production environment on a Honeywell mainframe computer.

(2) Redeveloped the model to incorporate lessons learned from the DRIVE prototype, ensured that the production model design was compatible with Air Force policy and improved the model efficiency in the production environment.

(3) Performed numerous tests on the model software to ensure that the model provided the desired results. We compared the production model results to the prototype model, performed numerous excursions and conducted timing studies on the model. We modified model code to improve model efficiency as highlighted by the timing studies.

(4) Provided the production version of the model ahead of schedule to the WSMIS SPO for incorporation into the DRIVE production system.

(5) Worked with the development contractors during model installation and System Test to ensure that they understood and properly applied the model. In turn, we used their feedback for debugging and runtime enhancements.

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B.1.c. **TITLE:** DRIVE Studies

CUSTOMER: HQ USAF/LE, AFLC/MMI/XPS/MAP/DSS, MAJCOM/LG

OBJECTIVE: Continue analysis support to the DRIVE effort in the areas of model enhancement, sensitivity analysis, data analysis and implementation issues.

RESULTS: We conducted, or were involved with, numerous analysis projects to support DRIVE production system development and implementation. Analysis areas included:

(1) Model/algorithm analysis - We had continuing discussions with RAND on the model logic and objective function. Their support was valuable in updating the model based on findings from both the OO-ALC prototype and the production system development effort. We also maintained a dialogue with LMI on related work and its potential application to DRIVE.

(2) Data analysis - The DRIVE model requires a considerable amount of data. Some have multiple automated sources while others may need to be input manually. We have operated with the philosophy that model software is only as effective as the data which feeds it. As a result, we conducted several efforts to help determine the accuracy and adequacy of data sources. We will pursue suspected problems with the officials responsible for the data system. Among these efforts, we:

(a) Began analysis of the base asset data source (D143H). We gathered evidence of problems related to the reporting of that data. The results will be provided to the data system OPR.

(b) Uncovered a significant irregularity in the reporting to the data system (D041) which provides item characteristics data (demand rate, etc). We provided our results to the data system OPR for resolution.

(c) Investigated data sources for repair resource data. This included a significant effort of acquiring and reviewing G028 data. We provided the results of our effort to the development contractors.

(d) Reviewed contractor developed input data and identified problems with the reported data. We provided the results of our efforts to the WSMIS SPO, DFIO and contractors. We worked with the contractors to help identify fixes to the problems.

(3) DEP REP/MOD Funding Allocation Process - We had several discussions with the development contractor and the Air Force functional OPRs for DEP REP/MOD (repair funding) to help ensure that functional requirements were understood by the contractor, that all parties understood the capabilities and potential uses of the DRIVE logic, and that DEP REP/MOD design considerations were incorporated in the production DRIVE system.

(4) Interface/Interaction with LMS Systems - We supported the DRIVE Functional Integration Office in identifying data requirements to interfacing data systems such as D073 and DMMIS. We also participated in discussions with representatives of the LMS systems to highlight potential interface disconnects and open the dialog for addressing these issues. Activity in 1990 should move to identification of specific strategies for dealing with these real and perceived differences.

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B.1.d. **TITLE:** DRIVE Extensions

CUSTOMER: USAF/LE, MAJCOM/LG, AFLC/MM/MA/DS/XP

OBJECTIVE: The DRIVE approach, and potentially the DRIVE algorit'.ms, offer a mechanism to support implementation of a number of initiatives under the banner of the Air Force Logistics Concept of Operations.

RESULTS: As the Air Force technical OPR for DRIVE, we were involved in the planning and design efforts for several of these initiatives. These include:

(1) Redistribution. We began a joint AFLC/TAF redistribution test using the DRIVE logic. We worked closely with the TAF, MMI and OO-ALC to design and begin a test using the DRIVE logic to identify redistribution candidates. Based upon DRIVE recommendations, Item Managers at OO-ALC initiated the redistribution actions and the TAF bases actually shipped the assets or reported why they could not complete the shipments. To support this, we used a RAND developed version of the DRIVE logic (REALL), continued development of the software, and worked with RAND to further refine it. The results of the test will highlight current systemic issues with data systems and the redistribution process, offer insights into redistribution policy issues, and help to define both Central and Theater redistribution processes in a DRIVE environment.

(2) Theater Distribution/Lateral Supply. The information gained from the Redistribution Test will also assist in the application of DRIVE to Theater Distribution. The REALL software will provide a prototype model and lessons learned from the test will also help define alternative system approaches. We also participated in continuing discussions with the AF/LEYS contractor developing the Functional Description and system description for the Theater/Region Allocation/Distribution Execution System (TRADES) project. That effort depends heavily on the results of the Redistribution Test.

(3) Mutual Support. Mutual support areas such as lateral repair received much less attention. We anticipate that development of tools to support these type decisions will build upon the framework developed by the DRIVE and Theater distribution systems. Further definitional work is expected in 1990.

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B.1.e. **TITLE:** Alternatives for Intermediate Maintenance (AIM) - A Case for Prioritization

CUSTOMER: AFLC/MM/MA/DS/XP, ALC/MM/MA/DS, MAJCOMs

OBJECTIVE: Examine how DRIVE could be used to support repair and distribution prioritization in an alternative maintenance concept where intermediate maintenance is accomplished at the depot rather than at the base.

RESULTS: We deviated from our primary DRIVE Development and Implementation support efforts to examine ways of quickly developing and implementing an "off-line" system to support the prioritization of repair and distribution of avionics items for the B-52H and KC-135 used in the pilot AIM effort where intermediate repair for K. I. Sawyer AFB was done at WR-ALC. We considered numerous repair concepts at the depot ranging from non-integrated to fully integrated and several options that ranged from support at only one depot to support at all depots for specific items. We developed plans to implement a DRIVE prioritization tool to support any final concept that might evolve, but the pilot was terminated in Dec 89 in favor of SAC Regional Maintenance Centers.

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B.2. Support for the Development and Implementation of WSMIS

B.2.a. **TITLE:** WSMIS Enhancements

CUSTOMER: LMSC/SMW, LOC, AFLC/MMI, MAJCOMs

OBJECTIVE: Take an active role in providing direction to the WSMIS Program Office, the development contractors, and users on various technical issues.

RESULTS: This year special emphasis was placed on generating spares-constrained capability assessments which look beyond day 30 of war. We prescribed parameter settings for the assessment model to use, guided discussions on support assumptions and data sources, and evaluated initial products. We discovered several errors in the WSMIS capability assessment system during the evaluations. We continued to advise the WSMIS Program Office and MMI on technical issues related to Strategic Airlift assessments and spares requirements computations.

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B.2.b. **TITLE:** Small Primary Aircraft Authorization (PAA) Modeling Problem

CUSTOMER: LMSC/SMW, LOC, HQ MAC, HQ SAC, HQ TAC

OBJECTIVE: Provide an improved methodology for assessing the impact that wartime spares would have on units with few aircraft. Focus primarily on the E-3A aircraft, for which WSMIS assessments are presently believed, by many, to be unsatisfactory.

RESULTS: We identified a number of problems peculiar to the E-3A modeling. A proposal for improving the assessments was formulated and provided to the customers. Our proposal includes:

(1) A technique for scrubbing NOP/ADJ item demand data,

(2) Applying mission essentiality and redundancy factors,

(3) Considering CONUS support for CONUS bases, and

(4) Applying option 20 of Dyna-METRIC to properly account for part failures.

We hosted a meeting of key players in December. At the meeting, HQ TAC representatives agreed to reconsider using WSMIS for E-3A assessments following the implementation of our proposal.

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B.2.c. **TITLE:** Dyna-METRIC and Support Software

CUSTOMER: LMSC/SMW, AFIT/LS, Air Force and Contractor Users

OBJECTIVE: Maintain the Dyna-METRIC model, develop support software, and provide a consultation service for Air Force users. Enhance Dyna-METRIC when necessary to enable it to model WSMIS/SAM and WSMIS/REALM applications. Advise the Dyna-METRIC User Group on technical issues. Teach Dyna-METRIC logic at AFIT courses LOG 290 and LOG 221.

RESULTS: We made significant improvements in the usefulness of the model so that it can handle large data files more efficiently and can be used for a broader range of applications. Particular attention was placed on the PC version of the model, where responsiveness and convenience are major factors. Over the year we helped many people use Dyna-METRIC and understand how and why it does what it does.

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B.2.d. **TITLE:** WRSK/BLSS Computation in WSMIS

CUSTOMER: AFLC/MM/XP, LOC, LMSC/SMW

OBJECTIVE: Provide guidance to contractors and project sponsors regarding the proper use of Dyna-METRIC and the Aircraft Sustainability Model (ASM) for determining aircraft spare parts requirements needed to support the first thirty days of wartime operations. Continue analyzing the data from the MAJCOM 30-day WRSK exercises conducted over the past three years. Continue working on

the team, headed by MMI, that is developing and validating a way to include battle damage spares in WRSK/BLSS kits.

RESULTS: We, of course, continued working with the various WSMIS contractors and project sponsors to help them implement the use of Dyna-METRIC and ASM to determine aircraft spare parts requirements. Areas of particular interest this year were whether to consider aircraft attrition when building WRSK/BLSS, the Air Staff proposed Logistics Priority Matrix which ranks all individual aircraft squadrons, the Air Staff proposed changes to DSOs as part of the Defense Management Review (DMR) initiatives, and the move from 30-day to 60-day WRSK/BLSS.

We completed analysis of the F-16C Coronet Warrior II exercise that TAC conducted in 1988. This analysis was very similar to the one done for the previous F-15C Coronet Warrior I exercise in that we built and evaluated several theoretical WRSKs using demand rates from various sources to gain insight into building better WRSKs. MMI produced a report describing our joint findings.

We continued working on the MMI headed battle damage team. This effort has not achieved much this year other than exchanging information with the U.S. Army concerning their techniques for computing battle damage spares. SURVIAC is under contract to validate the threat model, SCANMOD/REPAIR, which was used in the original joint AFSC/AFLC feasibility study, and we cannot proceed until SURVIAC delivers its report.

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B.2.e. **TITLE:** Lateral Resupply Studies

CUSTOMER: LMSC/SMW, LOC, HQ MAC

OBJECTIVE: Investigate alternative means of modeling wartime lateral spare support across bases. Refine the analytical technique employed in WSMIS/Strategic Airlift by calibrating the WSMIS analytic model based on a detailed simulation model (LRSS and/or Dyna-METRIC 6).

RESULTS: This study was put on hold for this year. Both Dyna-METRIC 6 and LRSS were not yet developed to the point where they could be used with confidence. We found a few problems with Dyna-METRIC 6 and LRSS and informed the developers of those simulation models. This effort will no longer be considered a separate study. In the future, it will be incorporated into Support for the Development and Implementation of WSMIS.

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B.3. **TITLE:** Updated C-17 Automatic Test Equipment (ATE) Basing Study

CUSTOMER: AFLC/XP

OBJECTIVE: The basic objective was to determine the most cost effective beddown scenario for the ATE needed to repair C-17 avionics parts in both peace and war. A major study to do this was conducted in 1987 and 1988 by the C-17 program office with Dyna-METRIC modeling technical guidance from our office. Alternatives ranging from a single depot supporting the world to ATE based at all nine C-17 CONUS bases, a PACAF base, a USAFE base and a depot were considered. The conclusion of that study was that the most cost-effective alternative consisted of ATE at three CONUS locations, a PACAF base, a USAFE base, and the depot. Because of work in AFLC of investigating alternatives to intermediate maintenance (AIM), AFLC/CC requested that a new review of the analysis be conducted to ensure that the modified two level alternative selected was truly the most cost effective approach.

RESULTS: The earlier study was reviewed by us and the C-17 SPO agreed that the study should be updated for three reasons:

1. Enough time had elapsed since the last study update that the available data was now better (more accurate and more complete).

2. Incorrect interpretation of Dyna-METRIC input data.

3. Even though some excursions were done to see how sensitive costs were to differences in resupply times, more should be done to determine if there truly was one option that was most cost-effective across a range of repair and transportation assumptions.

We obtained the latest LRU and SRU data from the C-17 SPO and began recomputing the spares costs using the Dyna-METRIC model. We concentrated our efforts on three scenarios -- depot only, the winner from the previous study, and a scenario MAC was favoring at the end of 1989 of two CONUS locations or Regional Maintenance Centers (RMCs) and a depot. We computed the spares costs varying the repair and transportation times from optimistic to pessimistic. This project will be continuing into 1990.

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C. OTHER DIVISION ACTIVITIES

We are the Air Force technical OPR for Dyna-METRIC -- a model that predicts aircraft availability as a function of parts. It also computes the spare parts needed to meet an aircraft availability goal. We gave many briefings on this model to interested parties including AFIT classes and foreign countries. This year we briefed visitors from West Germany, Canada, and Sweden. We gave copies of the model to several other Air Force offices, various Air Force contractors, and some foreign countries. We provided advice on the use of the model to other Air Force users and contractors, such as, the Air Force Audit Agency when they were trying to estimate the

impact on WRSK costs when repair codes (RR/RRR) or indenture relationships are miscoded, and the Institute for Defense Analysis (IDA) when they were using Dyna-METRIC for some R&M work with the F-15.

We worked with the management office which manages AFLC's scientific computer (CREATE) to write a computer system requirements document (CSRD) to replace our office's prime mainframe computer, the CREATE computer. As the major user of this system, XPS briefed the CSRD to the panel that made recommendations regarding which CSRDs should be funded.

D. THE PROGRAM FOR 1990

In 1990 our emphasis will focus on development and implementation of production DRIVE and the analysis and resolution of numerous policy and implementation issues that must be confronted. We anticipate working more heavily on extensions to the concept that will provide additional benefits such as redistribution and theater DRIVE. We will continue our WSMIS and Dyna-METRIC support to strive toward the most effective capability assessments feasible and WRSK computation processes that yield better support for dollars expended. We also anticipate completing the C-17 avionics automatic test equipment basing study. In addition, we plan to examine in some detail the idea of comparing spares requirements with and without the assumption of cannibalizations in peacetime.

Projects in our 1990 program are listed here in priority order.

D.1. Distribution and Repair in Variable Environments (DRIVE)

D.1.a **TITLE:** Implementation of DRIVE

CUSTOMER: USAF/LE, AFLC/MM/MA/DS/PM/XP, ALC/MM/MA/DS/PM, MAJCOMs

OBJECTIVE: Continue support of the implementation of DRIVE within the framework of the AFLC data system structure. Our focus will transition from development to implementation support during the year. Our responsibility will be as the Air Force technical OPR for the DRIVE model and technical consultant to the DRIVE Functional Integration Office. In this capacity, we will:

(1) Maintain the production model software and incorporate necessary modifications uncovered during system test. We will also accomplish the necessary analysis efforts to support model maintenance.

(2) Continue to provide technical guidance to the DRIVE Functional Integration Office (DFIO) in evaluating contractor proposals, assessing needed analysis efforts and determining recommended policy and procedural impacts and solutions. Project D.1.c., DRIVE Studies, outlines some of the efforts planned to support this function.

(3) Continue to provide guidance to the contractors' design and development efforts and evaluate the progress and adequacy of those efforts. This task is especially important as XPS and two contractors are developing the DRIVE segments - DRIVE model, unclassified process, and classified process.

(4) Examine the support concepts that will be used under the new Regional Maintenance Center initiatives being implemented by the MAJCOMs so we can identify to them what additional data they must provide us to enable us to distribute assets (LRUs and SRUs) appropriately.

(5) Continue to support the DRIVE prototype at OO-ALC and use it as a field laboratory for model development. This activity will be supplanted by the production system during 1990.

ANTICIPATED BENEFITS: DRIVE provides a means of explicitly linking depot support to operational needs. First, it will prioritize near term depot repair and distribution actions to best support the expected needs of the operational units within the constaints of the corporate Air Force priorities and DEP REP/MOD funding. Second, it will provide optimal quantities of repair requirements for use in quarterly repair negotiations. Third, it will provide tools to help funds managers allocate DEP REP/MOD funds to ALCs to maximize aircraft availability. Additionally, there are many other areas, discussed in Project D.1.d, where DRIVE logic can be applied to retail level logistics problems. We will use our experience from implementing Dyna-METRIC in WSMIS/SAM to preclude many of the problems inherent in the design of new systems.

ESTIMATED COMPLETION DATE: December 1990

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D.1.b. **TITLE:** DRIVE Model Maintenance

CUSTOMER: AFLC/MMI/XPS, LMSC/SMW

OBJECTIVE: To maintain the production DRIVE model and provide the software to the WSMIS SPO. We will continue our efforts to ensure that the production model is compatible with Air Force policy and that the model operates efficiently in the production environment.

We will conduct analysis efforts to support model development. Project D.1.c, DRIVE Studies, addresses this in more detail. We

will also incorporate 'lessons learned' from DRIVE production system development activities.

ANTICIPATED BENEFITS: DRIVE provides a link between depot repair and distribution actions and our warfighting strategy through the DRIVE model logic. To respond in a timely manner to the dynamics of the logistics environment, however, the model must be designed efficiently to accommodate runs containing a multitude of parts and bases.

ESTIMATED COMPLETION DATE: Continuing

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D.1.c. **TITLE:** DRIVE Studies

CUSTOMER: HQ USAF/LE, AFLC/MMI/XPS/MAP/DSS, MAJCOM/LG

OBJECTIVE: Conduct, or oversee, analysis projects to support DRIVE production system development and implementation. Analysis areas include:

(1) Model/algorithm analysis - We must verify that DRIVE will provide support in a manner in which it was intended. Of prime importance here is investigation of the objective function to insure that it is operating as intended.

(2) Data analysis - The DRIVE model requires a considerable amount of data. Some have multiple automated sources while others may need to be input manually. We will first focus on the Air Force Recoverable Assemblies Management System (AFRAMS), D143H, which provides base level asset reporting to DRIVE. This is probably the single most important system feeding data to DRIVE, as well as to current AFLC processes. Other data systems will be reviewed as time becomes available.

(3) Policy analysis - The DRIVE approach to repair and distribution prioritization impacts a number of policies and offers the potential for improvement in AFLC's support to the operational commands. The impact of these policies on DRIVE's return, and what DRIVE means to various existing policies, must be understood to ensure that DRIVE reflects policy and that needed policy changes are highlighted. Examples include the use of base specific rather than worldwide average demand rates and the relationship of DRIVE to the current method (D028) of setting base asset level authoritizations. We intend to examine this process to see if using DRIVE logic to replace the existing logic will have the perceived payoffs.

(4) DEP REP/MOD Allocation Process - Continuing efforts will

be needed to understand how DRIVE should operate, the interfaces required and the information needed to adequately support this process. We will work with the DRIVE development team to help ensure that the DRIVE design to support this process is appropriate and operates as desired.

(5) Interface/Interaction with LMS Systems - As with policy issues, LMS interfaces and requirements of receiving systems can impact system design. These issues need to be addressed further with the interfacing system representatives. The DRIVE model design should incorporate any required changes resulting from these issues.

ANTICIPATED BENEFITS: By fully understanding the model and its data, we will be able to preclude many difficulties that could occur once DRIVE becomes a production system. Also, by investigating areas that would be affected by DRIVE, we will be able to design the system to minimize potential conflicts and maximize the benefits that can be derived from it. Even after system implementation, continuing efforts will ensure that the model provides maximum benefits within the context of corporate Air Force policies.

ESTIMATED COMPLETION DATE: Continuing

ANALYSTS: Mr Curtis Neumann,
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Mr Richard Moore,
Ms Karen Klinger,
Ms Barbara Wieland,
Mr Michael Niklas,
Capt Frank Lindenbach,
Ms Jennifer Musick,
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D.1.d. **TITLE:** DRIVE Extensions

CUSTOMER: USAF/LE, MAJCOM/LG, AFLC/MM/MA/DS/XP

OBJECTIVE: The DRIVE logic and approach were an outgrowth of the RAND Uncertainty studies. The results of these studies also played a major part in the formulation in the new Air Force Logistics Concept of Operation (LOGCONOPS). The major initiatives that we will be involved with include:

(1) Redistribution. DRIVE offers potential as a tool to help guide theater and worldwide redistribution actions. The joint AFLC/TAF test of the concept will continue through mid-1990. This effort will help define the benefits, design considerations, and implementation issues for a redistribution system which takes advantage of DRIVE logic. Current systemic limitations will also be identified to the appropriate agencies and corrective action pursued.

(2) Theater Distribution/Lateral Supply. DRIVE logic also holds promise for distribution of assets new to the theater or to

the movement of assets between bases within the theater (lateral supply). The challenge will be to integrate the AFLC DRIVE implementation with theater DRIVE. A theater DRIVE would be "owned" and operated by each theater MAJCOM, but its data sources and logic would be integrated with the AFLC DRIVE. We will work closely with HQ USAF/LEYS and the MAJCOMs to define alternative designs for accomplishing the AFLOGCONOPS and Supply 2010 objectives.

(3) Mutual Support. Longer-term efforts are also needed in mutual support areas such as lateral repair. In war, a base may lose repair capability, or suffer from a critical shortage, while a base in the same theater may be able to assist by supplying some repair capacity. This problem also arises in peace when units deploy on an exercise and rely on local base maintenance to repair unserviceables that generate during the exercise. The question that arises is, "What should the local base maintenance do first and who does it devote repair capacity to?" A DRIVE-like model could function much like the AFLC DRIVE and prioritize the repair that is done and the bases which should receive the serviceable assets. 1990 efforts will most likely center on problem and system definition. Mutual Support developments must follow the lead of the lateral supply initiatives.

ANTICIPATED BENEFITS: The benefits of DRIVE will be expanded through the implementation of these projects. The benefits will consist of increased readiness and sustainability, greater logistics flexibility and responsiveness to operational needs, and a truly integrated wholesale-retail logistics system. This would all be accomplished within, or at lower than, current operating cost constraints.

ESTIMATED COMPLETION DATE: December 1990

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D.2. **TITLE:** Support for the Development and Implementation of WSMIS

CUSTOMERS: LMSC/SMW, LOC, AFLC/MMI, MAJCOMs

OBJECTIVE: Take an active role in providing direction to the WSMIS Program Office, the development contractors, and users on various technical issues.

ANTICIPATED BENEFITS: Improved accuracy, usefulness, and responsiveness of WSMIS in areas which most need our support. Our technical expertise and operational experience enable us to provide fast, effective corrections and enhancements to the system. Anticipated reductions in contract money will increase the demand for our services.

ANALYSTS: Mr Michael Niklas,
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D.3. **TITLE:** Dyna-METRIC and Support Software

CUSTOMER: LMSC/SMW, AFIT/LS, Air Force users

OBJECTIVE: Maintain the Dyna-METRIC model, develop support software, and provide a consultation service for Air Force users. Enhance Dyna-METRIC when necessary to enable it to model particular real-world situations as well as to support specific WSMIS/SAM and WSMIS/REALM applications. Advise the Dyna-METRIC User Group on technical issues. Teach Dyna-METRIC logic at AFIT courses LOG 290 and LOG 221. Also manage and maintain the Dyna-METRIC Microcomputer Analysis System (DMAS).

ANTICIPATED BENEFITS: Dyna-METRIC is a state-of-the-art logistics support model with many diverse applications. As the heart of WSMIS/SAM, it is being used to develop unit-level C-ratings. It is beginning to be used in WSMIS/REALM for engine and WRSK requirements computations. Maintaining the currency of the model, simplifying its use, and informing users of its capabilities and limitations helps ensure that the model will be applied correctly. This is extremely important, since many high level decisions and budget allocations are influenced by output from Dyna-METRIC.

ESTIMATED COMPLETION DATE: Continuing.

ANALYSTS: Mr Michael Niklas,
Ms Karen Klinger,
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D.4. **TITLE:** WRSK/BLSS Computation in WSMIS

CUSTOMER: AFLC/MM/XP, LOC, LMSC/SMW

OBJECTIVE: Continue providing guidance to contractors and project sponsors regarding the proper use of Dyna-METRIC and the Aircraft Availability Sustainability Model (ASM) for determining aircraft spare parts requirements. Continue working on the team headed by AFLC/MMIS that is developing and validating a way to include battle damage spares in the WRSK/BLSS kits.

ANTICIPATED BENEFITS: We have been part of the continuing effort to replace the former WRSK/BLSS computation methodology with Dyna-METRIC because Dyna-METRIC considers LRU-SRU relationships correctly which results in leaner, cheaper kits. After the initial implementation of Dyna-METRIC, we recommended that WSMIS/REALM incorporate the Logistics Management Institute's ASM model which is based on Dyna-METRIC methodology but better considers LRU-SRU and echelon trade-offs which result in even leaner and cheaper kits.

However, in the area of battle damage, our efforts will probably result in the spending of more money on WRSK/BLSS. Other than for the A-10, the Air Force has not included spares for battle damage. Our work so far has shown that we could be making a serious mistake by not considering battle damage spares.

ESTIMATED COMPLETION DATE: Portions of this project will continue into 1991.

ANALYST: Ms Barbara Wieland; Com (513) 257-6920; AV 787-6920

D.5. **TITLE:** Updated C-17 Automatic Test Equipment (ATE) Basing Study

CUSTOMER: AFLC/XP

OBJECTIVE: The basic objective of this study is to determine the most cost effective beddown scenario for the ATE needed to repair C-17 avionics parts in both peace and war. A major study to do this was conducted in 1987 and 1988 by the C-17 program office with Dyna-METRIC modeling guidance from our office. Alternatives ranging from a single depot supporting the world to ATE based at all nine C-17 CONUS bases, a PACAF base, a USAFE base, and a depot were considered. The conclusion of that study was that the most cost-effective alternative consisted of ATE at three CONUS locations, a PACAF base, a USAFE base, and the depot. Because of work in AFLC of investigating Alternatives to Intermediate Maintenance (AIM), AFLC/CC requested in Oct 1989 that a new review of the analysis be conducted to ensure that the modified two level alternative selected was truly the most cost effective approach.

ANTICIPATED BENEFITS: By updating or redoing portions of the earlier C-17 ATE study using the latest available data, we will either confirm the earlier selection of the option with three CONUS and two overseas Regional Maintenance Centers (RMCs) or propose that MAC go with another option, such as, depot only supporting the world (two-level).

ESTIMATED COMPLETION DATE: April 1990

ANALYSTS: Ms Barbara Wieland,
Mr Michael Niklas; Com (513) 257-6920; AV 787-6920

D.6. **TITLE:** Impact of Considering Cannibalization on the Peacetime and the Total Aircraft Spares Requirements

CUSTOMER: AFLC/XP

OBJECTIVE: Using C-17, F-15, and F-16 aircraft spares data, estimate peacetime spares requirements with cannibalization. The current computation does not consider cannibalization. Also, determine the effect of such a peacetime stocking policy on the wartime spares requirements.

ANTICIPATED BENEFITS: Doing this study will help the Air Force determine if it would be a smart idea to change the cannibalization assumptions for our peacetime requirements computation system. It is possible that there are large peacetime spares cost savings associated with computing assuming cannibalization. However, having fewer spares in peacetime may drive up the wartime spares requirements costs significantly.

ESTIMATED COMPLETION DATE: July 1990

ANALYSTS: Mr Michael R. Niklas,
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Curtis E. Neumann

CURTIS E. NEUMANN
Chief, Assessment Applications Division
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III. THE CONCEPT DEVELOPMENT DIVISION

A. INTRODUCTION

The Concept Development Division, XPSC, provides a source of expertise within the Headquarters for several computer models/systems used by AFLC. Our focus has been on the recoverable item requirements process and the allocation of those requirements between the wholesale and retail levels. We have been primarily concerned with determining end item readiness (aircraft availability) as a function of spares dollars (BP1500 expenditures). In fact, we are the AFLC technical OPR for the Aircraft Availability Procurement Model (AAPM), which incorporates aircraft availability objectives into the Recoverable Item Requirements System (D041). Our staff consists of six operations research analysts and one computer assistant. All of our analysts are focusing their efforts on improving the AFLC requirements process. This includes the D041 and D028 Systems. Two of our analysts worked on identifying and assessing the procedures AFLC currently uses to select items for reliability and maintainability improvements for the purpose of improving this process.

B. ACCOMPLISHMENTS IN 1989

In 1989 we completed two projects: Identifying Candidate Items for Reliability and Maintainability Improvements in AFLC and Maintenance Manpower, Spares Costs, and Repair Costs Impacts of Going to Two Levels of Maintenance for the B-52H and KC-135. We responded to all requests on one project, Support the Use of Aircraft Availability Requirement Techniques in D041, and made substantial progress on two others, the D028 Central Leveling System Data Base and Impact of Changes in Order and Ship Times (O&STs) and Depot Repair Cycle Times (DRCTs) on Aircraft Availability and Procurement Costs. We also made some progress on Evaluation of Aircraft Spares Demand Forecasting Techniques.

B.1. **TITLE:** Support the Use of Aircraft Availability Requirement Techniques in D041

CUSTOMER: AFLC/MMI

OBJECTIVE: Respond to requests for assistance in interpreting results and resolving problems with the aircraft availability requirement techniques in D041.

RESULTS: We responded to a request to investigate reasons for fluctuations in the safety levels computed for each quarter of the 25 quarters contained in the D041 requirements computation. In some cases safety level fluctuations were occurring between quarters with very little change in the requirement factors. It was found that the Aircraft Availability Model (AAM) could be sensitive to small changes in the base and/or depot pipeline requirements in the allocation of the total stock level between the base and depot.

The current technique for capping stock levels (the aggregate method), which was implemented to solve a problem with increased

repair requirements using the AAM, does not handle this situation very well. The reason being that it caps the base and depot stock levels independent of each other.

To resolve this problem we proposed replacing the current capping technique with what we call the total cap method. The new capping logic considers both the base and depot stock levels together in establishing the maximum amount of safety level.

We were able to propose two alternatives for using the total cap method. One alternative capped both the base and depot stock levels at a fixed number of standard deviations of safety stock. The other alternative used a fixed number of standard deviations of safety stock to cap the base stock level but a variable number of standard deviations of safety stock to cap the depot stock level. The variable number of standard deviations used to cap the depot stock level is based on the number of standard deviations of safety stock computed by the AAM at each of four key quarters (first, buy, term, and POM).

The CREATE version of the AAM was used to obtain the procurement and repair cost impacts of using the total cap method.

Briefings were provided to MMIRS personnel on both alternatives. The briefings included detailed explanations of the methods employed by each total cap alternative, cost impacts, and implementation issues. In addition, for 16 National Stock Numbers (NSNs) identified by MMIRS as having problems with fluctuating safety levels, examples of how each of the two alternatives would impact the safety levels for each of the NSNs were provided.

MMIRS is continuing its analysis of the information we provided them.

We were also requested by MMIRS to determine the procurement cost differences between using the current target aircraft availability goals and if all aircraft availability goals were established at 90%. We were asked to do this at the buy, term and POM points. At the same time, we were asked to determine the stock level capping impacts of using 90% goals -- the percentage of NSNs where either the base, depot or both stock levels produced by the 90% goals had to be capped. We obtained these percentages for all NSNs as well as for those only in a buy position. The current method (the aggregate method) was used to determine the base and depot stock level caps.

The CREATE version of the AAM was used to obtain the necessary information to complete this task. Using data from the September 1988 D041 requirements computation, the results showed that we could expect an approximate 250 million dollar increase when using the 90 percent goals as opposed to using the current goals. The percentage of all NSNs where either the base, depot, or both stock levels were capped increased by approximately 2 percent from 67 to 69 percent. The percentage of NSNs in a buy position where either the base, depot, or both stock levels were capped increased by approximately 5 percent from 40 to 45 percent. These results were provided to MMIRS.

In addition to responding to the above requests, we are currently investigating a possible problem with the levels of indenture files involving National Stock Numbers (NSNs) with applications to next higher assemblies on more than one level.

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B.2. **TITLE:** Analyzing the Decision Process for Identifying High-Payoff Items for Reliability and Maintainability Improvement

CUSTOMER: AFLC/MM-R

OBJECTIVES:

1. Develop a thorough understanding of the current process for identifying, selecting, and evaluating opportunities for R&M improvement, and clearly describe the inputs, steps, and outputs of the process.

2. Identify problems within the process.

3. Determine how the process should work.

4. If necessary, recommend how the process should be improved. "Improved" could mean more proactive, efficient, effective, standardized, routine, cheaper, or some other appropriate measure. Consider reducing expenditures through the exploitation of opportunities for R&M improvement

RESULTS: The study revealed that AFLC has no specified procedure, standardized across all ALCs, for identifying high payoff items for R&M improvement. In most cases, the responsibility for defining and executing such a procedure is delegated down to the management division level at each ALC (the SPM or IM division). Without a standard AFLC procedure for identifying high payoff items for R&M improvement, data sources, screening techniques, and measures of effectiveness are not comparable across organizational (division) lines. As a consequence, AFLC senior management has no way of knowing if potentially high payoff R&M improvements are making it through or are falling through the cracks in these differing processes.

The study found, in one instance, an exception to this trend toward management division autonomy. WR-ALC is implementing a standardized process called Product Team Management (PTM). PTM forms product teams of non-supervisory experts from key areas of system support (equipment specialists, item managers, engineers, maintenance personnel, etc.) for each system and major subsystem. Each team member is responsible for providing the team with data and insight from that member's field of expertise. The team meets regularly to combine these expert assessments into a comprehensive, evolving system management program.

The primary recommendation of this study was that AFLC develop and implement an effective standardized procedure for identifying R&M improvements. The study further recommended that Product Team Management, as set forth in the draft AFLC Supplement to AFR 800-18 and WR-ALC/MM OI 800-19, should form the nucleus of this command-wide policy. PTM capitalizes on a major strength of the command--its working-level functional experts. PTM combines these experts and provides a proactive means for carrying out their collective recommendations. PTM also allows senior management to review documentation of the decision process. Such documentation includes minutes from the regularly scheduled product team meetings, item evaluation worksheets, and data base screens. In this way, AFLC will know not only which items are selected for R&M improvement, but which are considered but not selected, and why.

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B.3. **TITLE:** Maintenance Manpower, Spares Costs, and Repair Costs Impacts of Going to Two Levels of Maintenance for the B-52H and KC-135.

CUSTOMER: AFLC/XP

OBJECTIVE: Examine the maintenance manpower, spares costs, and repair costs impacts of going from three to two levels of maintenance on avionics spares for the B-52H and the KC-135.

RESULTS: We used traditional queueing formulae to study the effect on maintenance manpower requirements of combining a number of base repair facilities into one centralized facility. We showed that substantial savings in maintenance manpower could be achieved through the consolidation of base repair shops at a central facility. We used the CREATE version of the Aircraft Availability Procurement Model (AAPM) to study the spares costs impacts of going from a three level to a two level maintenance concept (The AAPM is used in the D041 requirements computation to compute stock levels for Budget Program 15 items). We used the CREATE AAPM to show how changes in resupply times reduce or increase spares requirements. We considered two cases in our analysis:

<u>Case I:</u> The AAPM was run with the Sept 1988 D041 Requirements Computation data to create a baseline. Six additional runs were then made where we adjusted the resupply times to reflect a two levels of maintenance policy. These six scenarios showed how spares requirements fluctuate as resupply times vary.

<u>Case II:</u> For this case, we reduced the resupply times in the Sept 1988 requirements data to create a new baseline. We made this excursion because we believe that we don't achieve real world aircraft availability rates with the resupply times currently in D041. We believe this because the average resupply times in D041 are based on low priority requisitions. As in Case I, we then made six more AAPM runs where we varied the resupply times input to the model.

In both Case I and Case II, we looked at POS costs only and also at POS plus WRSK/BLSS costs.

Our analysis showed that more responsive resupply times could reduce and possibly eliminate the need for more spares as we switch to two levels of maintenance. Additionally, more responsive resupply times can mean big spares savings for three levels of maintenance.

The study's bottom line is: while we don't know what it would cost to achieve the resupply times we have investigated, the impact on spares and/or aircraft availability is so great we believe the AFLC needs to look at ways of achieving more responsive resupply times.

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B.4. **TITLE:** Effects of Changes in Order and Ship Times (O&STs) and Depot Repair Cycle Times (DRCTs) on Aircraft Availability and Procurement Costs

CUSTOMER: HQ AFLC/XP

OBJECTIVE: Determine how changes in O&STs and DRCTs affect procurement costs and/or worldwide aircraft availability for all, or selected, weapon systems.

RESULTS: We are using the CREATE Aircraft Availability Procurement Model (AAPM) to make the necessary runs to accomplish the objectives of this study. We are making two sets of computer runs. One set utilized current assets and looked at aircraft availability versus procurement dollars (POS + WRSK/BLSS) for the current resupply time and resupply times of 60, 40, and 20 days. In addition, to get a feel for what a one day change in the transportation time for both reparables and serviceables has on aircraft availabilities and/or costs, we made two additional runs for each of the four resupply times investigated. One of the additional runs increased the transportation times by one day. The other decreased the transportation times by one day. All the computer runs have been completed for this set and analysis has begun. The second set of runs will be the same as the first set except we will assume we have zero assets and only POS costs will be considered. We have completed most of these runs.

Preliminary analysis (runs using current assets) shows that for specific worldwide aircraft availability goals substantial savings in spares costs (POS + WRSK/BLSS) can be achieved by reducing the resupply times.

Preliminary analysis of the second set of runs where we assumed zero assets shows that the savings are substantially greater to maintain or achieve the same specified worldwide aircraft availability goal. This is to be expected. This project will continue into 1990.

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B.5. **TITLE:** Evaluation of Aircraft Spares Demand Forecasting Techniques

CUSTOMER: AFLC/MMI

OBJECTIVES: Determine how we make forecasts for buy and repair decisions and examine how well we are doing (Phase 1). Use data from Phase 1 to improve procedures for maintaining and developing D041 factors (Phase 2).

RESULTS: The first phase of the study consists of two parts - a statistical analysis to determine how well we are doing and a survey of equipment specialists and their supervisors to determine how we make the forecast.

Regarding the survey, we designed it so it would provide us an understanding of the equipment specialist's role in determining and maintaining the D041 factors: techniques used, environment in which they work and extent of responsibility. We also wanted to find out when the equipment specialists override the D041 system computed factors, why they do it, and how they determine their estimated factor values. We completed the design of a test survey for equipment specialists and also one for the supervisors of equipment specialists which we sent out to selected equipment specialists and the supervisors of equipment specialists at each of the Air Logistic Centers (ALCs). We asked that the surveys be evaluated for appropriateness, completeness, difficulty, and length. Overall, the reaction was positive. The recommended changes were generally cosmetic and most were incorporated in the final surveys which have been distributed. We sent out 388 surveys covering all ALCs.

Regarding the statistical analysis, we constructed a data base by extracting data from the March 1985, 1986, 1987, June 1987, September 1987, March 1988, June 1988, and the September 1988 D041 Depot Data Bank. We reviewed this data for completeness and consistency (e.g. did the Total Organizational and Intermediate Demand Rate (TOIMDR) included in the data base equal the sum of base demands over the past two years divided by the program) and the results were excellent.

Our first analysis involved investigating the frequency of equipment specialist estimation of the TOIMDR and Not Reparable This Station (NRTS) factors. The results of this analysis showed that the TOIMDR is estimated somewhere between 14 - 20 % of the time, while the NRTS is estimated 10 - 12 % of the time. Together, roughly 20 % of the items in a given computation have one or both of these factors estimated. Another interesting result showed that 40% of the items that were in all eight of the computations that we had information for had one or both of these factors estimated at one time or another. This meant that the same items were not being estimated continually; different items were being estimated during the different computations.

Analysis has begun that looks at the effectiveness of the forecast. We will look at the short term forecast first (that used for repair projections). This analysis will show how well we make the forecast and its impact on the inventory position. This project will continue into 1990.

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B.6. **TITLE:** D028 Central Leveling System Data Base

CUSTOMER: AFLC/MMI

OBJECTIVE: Investigate software for on-line viewing and develop a users manual. Develop specifications for the transfer of this data base to LMSC for maintenance

RESULTS: We did not investigate software for on-line viewing, rather, we developed batch programs for extracting the historical data. We are in the process of developing a manual for using the batch programs. Specifications for establishing and maintaining the history data base have been written along with the necessary computer programs. The current history data base contains nine quarters of data beginning with the third quarter of calendar year 1987 and continuing through the third quarter of calendar year 1989. We are currently processing data from the fourth quarter of 1989.

We have developed several batch programs for extracting data from the history data base. One extracts user data by National Stock Number, another extracts user data by Stock Record Account Number (SRAN), and another extracts item data summarized over all users by National Stock Number. We are developing user friendly time sharing programs to use the batch programs to extract data.

We have briefed MMIR and MMIA personnel on the contents of the data base. The data base has been used to obtain base daily demand rates by quarter for calendar year 1988 to help explain a problem with D041 demand rates for several OO-ALC DRIVE items. The D041 useage data show a large increase in base demands for these items in the last quarter of calendar year 1988. The data base is currently being used by XPSA to obtain 1989 user data for OO-ALC items. This project will continue into 1990.

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C. OTHER DIVISION ACTIVITIES

As the Air Force technical experts on Mod-METRIC (an initial provisioning model), our services are often sought as technical advisors and consultants. At the request of ASD/YFL we provided information on Mod-METRIC to both Lockheed and Northrop corporations for them to use to develop initial provisioning requirements for the Advanced Tactical Fighter. We assisted Lockheed in getting Mod-METRIC to run on its IBM mainframe computer. Information on

Mod-METRIC was provided to the Canadian Defense Forces. We provided technical guidance to the LOC/PN and AFLC/ACC on the use of Mod-METRIC to compute spare engine requirements. We maintain the Mod-METRIC algorithm on two computer systems (CREATE and WWMCCS). We also maintain a PC version of Mod-METRIC.

We are the Air Force technical experts on the D028 Central Leveling System. We provide assistance in identifying and implementing changes to improve the D028 algorithm; and, in resolving problems with the running of the D028 Central Leveling System. Both these actions require, in some instances, that we work directly with the data automation OPR for maintaining and running the D028 Central Leveling System, SA-ALC/SCDR. Under CYBER REHOST we played an important role in the successful transfer of the D028 algorithm from a CYBER to an AMDAHL computer. Due to differences in machine accuracy, this action required changes to the algorithm's logic to properly process items with large pipelines. We developed the necessary changes, tested them and saw that they were properly implemented. After our changes were implemented, we compared the results of running D028 on the CYBER versus an AMDAHL computer. They were almost identical: the sum of the world-wide expected backorders for SA-ALC items differed by only .002, only 2 of 25,042 user levels and only 4 of 25,042 user expected backorder rates were different. We maintain a research version of the D028 algorithm on CREATE for special studies.

We do technical evaluations of contractor proposals and studies. We provide technical assistance to contractors where appropriate.

We review technical documents for potential AFLC applications.

We provide administrative and technical assistance to the DCS Office Information System (OIS). The DCS OIS facilitates routine office operations, enhances communications, both internal to the DCS and external, and improves access to information.

We develop and assist in the development of micro computer applications.

We are the Air Force technical experts for the modeling techniques utilized by the Recoverable Item Requirements System (D041). This includes both the Variable Safety Level (VSL) and aircraft availability algorithms. In this capacity:

a. We were able to explain to the General Accounting Office (GAO) the differences between the VSL and aircraft availability algorithms and were able to provide information to them on the validation of the aircraft availability algorithms.

b. We responded to a request by the GAO to explain the techniques used in the aircraft availability algorithm to compute expected backorders. To help in the explanation, we were able to provide the GAO representatives a document we prepared for the Air Force Audit Agency (AFAA) describing in detail the mathematical procedures used to compute expected backorders in the aircraft availability algorithms. The document we provided the AFAA was used

by it to validate the mathematical accuracy of the aircraft availability algorithms.

c. At the request of MMIRS, we participated in a review of the Process Functional Descriptions describing the procedures to be used in the Requirements Data Bank (RDB) being developed by BDM for incorporating the VSL and aircraft availability algorithms. The RDB is a data automation effort to enhance and modernize our requirements computation systems.

d. We briefed a representative from Sweden (SAAB-Scania AB) on the differences between VSL and aircraft availability algorithms.

e. We completed a writeup of the aircraft availability algorithms for inclusion in the Logistics Support Analysis Guide - AMC Pamphlet 700-4.

f. We put together a documentation package describing the aircraft availability algorithms: input data requirements, specifications, computer programs, procedures for running on the CREATE computer and an overview of the entire process.

g. We provided MMIRS assistance in answering its DCS's questions regarding replacing D041 with Dyna-METRIC and incorporating cannibalization considerations in the aircraft availability stock level computation.

h. We provided information on the indenture relationships used by the AAPM - how they were developed, number of items on each of the five levels, number of items having subcomponents, maximum number of sub- components, etc. for use in the development and/or design of DRIVE.

We maintain research versions of both the VSL and aircraft availability algorithms on CREATE. We use this capability for special studies and to test proposed changes to the production algorithms. Some of the special studies we have used this capability for have already been discussed. Others include providing Air Staff (LEXX) a computerized data base of the 1% tables; and, providing ALD/YZLR safety levels for engine components by weapon system. The 1% tables display aircraft availability versus dollar costs by weapon system.

We assist in maintaining and updating the mathematical documentation of both the VSL and aircraft availability algorithms.

We maintain several data bases for running both the Aircraft Availability Model (AAM) and VSL on CREATE. Data from the D041 requirements computation is supplied to us each quarter by OC-ALC to run the AAM. This data must be converted from standard IBM format to Honeywell format for use on the CREATE system. Data for running the VSL model must be obtained from the D041 Depot Data Bank.

We participated in the A-10 Coronet Warrior III exercise at England AFB. We were involved in collecting data on flightline configurations, flightline maintenance, support equipment

utilization, and manpower utilization. This exercise gave us an opportunity to allow some of our newer analysts to obtain first hand experience on base level flightline activities.

We obtained information on the D041 buy and budgeting process which we used to brief XP on how the DC41 generates the data required for these processes.

We were involved in several process action teams - one of which was used to improve the Directorate's security practices, another one was to investigate and reduce the amount of time it takes for documents to process throughout XP, and one other involved a redesign of the XPS Office Instruction (OI) for conducting studies. The new OI was designed to improve the quality of the studies conducted by the Directorate.

We have established a D028 historical data base which we are currently maintaining.

We provided assistance in developing a Computer System Requirements Document for upgrading the CREATE computer.

We provided yearly demand data to personnel from AFLC/XPR on KC-135 and B-52H avionic items to assist them in their Alternative to Intermediate Level Maintenance project. This information was obtained from the data base we put together for the demand forecasting study. We also used this data base to assure the D041 dirty data cleanup was accomplished successfully (we did this task for MMIA) and investigated some F-16 DRIVE items showing significant increases in demands.

D. THE PROGRAM FOR 1990

We will continue to provide the technical support for using aircraft availability in the D041 requirements computation. We expect to continue responding to requests for assistance in interpreting results; we will also be available for resolving problems that may arise. We will develop a Process Functional Description in order to facilitate the understanding of the mathematical techniques contained in the Aircraft Availability Model and how they are utilized in the solution process.

We will continue with our evaluation of the techniques being used to forecast demands for aircraft recoverable spares and their impact on procurement and repair decisions.

We will continue our work with responsive resupply times. We need to complete and document the results of our study on the impact of changes in resupply times on weapon system availability and procurement costs. We will, if our resources permit, do a study on how resupply times used in the D041 requirements computation vary over time. We also expect to be tasked to do further studies in this area.

With the Requirements Data Bank now beginning its development of the requirements computation for recoverable spares, we will support

this development by serving as technical consultants on the mathematical techniques being utilized.

We will do a study evaluating alternative strategies for handling maintenance dollar shortfalls for exchangeable spares.

We will continue to provide technical support to the D028 Central Leveling System.

If our resources permit we will also initiate projects to incorporate engine data into the aircraft availability requirements computation, better use the Aircraft Availability Model to determine maintenance requirements, and improve the handling of weapon systems phasing in or out in the Aircraft Availability Model.

Our 1990 projects are listed in priority order below.

D.1. **TITLE:** Support the Use of Aircraft Availability Requirement Techniques in D041.

CUSTOMER: AFLC/MMI

OBJECTIVE: Respond to requests for assistance in interpreting aircraft availability results. Resolve problems that may arise with the use of aircraft availability requirement techniques in D041. Develop a Process Functional Description of the Aircraft Availability Model (AAM).

ANTICIPATED BENEFITS: Improved understanding of the aircraft availability results. Resolve problems that may arise with the use of aircraft availability requirement techniques in D041. Help facilitate understanding of the mathematical techniques contained in the AAM and how they are utilized in the solution process.

ESTIMATED COMPLETION DATE: Continuing.

PROJECT LEADER: Capt Roger Moulder; Com (513) 257-6920;
AV 787-6920

OTHER ANALYSTS: Mr Fred Rexroad,
Mr Bill Morgan; Com (513) 257-6920;
AV 787-6920

PROJECT OVERSEER: Mr Jack Hill; Com (513) 257-6920;
AV 787-6920

D.2. **TITLE:** Evaluation of Aircraft Spares Demand Forecasting Techniques.

CUSTOMER: AFLC/MMI

OBJECTIVES: The objectives of this study are two fold. Determine how we make forecasts for buy and repair decisions and examine how well we are doing (Phase 1). Use data from Phase 1 to improve procedures for maintaining and developing D041 factors (Phase 2).

ANTICIPATED BENEFITS: Ultimately, selection of improved forecasting techniques will result in more accurate repair workload and budget estimates thereby improving inventory positions -- fewer items in shortage and excess positions. Consequently, more weapon systems will be available and less money will be wasted investing in unneeded maintenance and parts.

ESTIMATED COMPLETION DATE: Phase I: Sep 1990
Phase II: TBD

PROJECT LEADER: Capt Carol Weaver; Com (513) 257-6920; AV 787-6920

OTHER ANALYSTS: Mr Bill Morgan; Com (513) 257-6920; AV 787-6920
Mr Fred Rexroad; Com (513) 257-6920; AV 787-6920

PROJECT OVERSEER: Mr Jack Hill; Com (513) 257-6920; AV 787-6920

D.3. **TITLE:** Effects of Changes in Order and Ship Times (O&STs) and Depot Repair Cycle Times (DRCTs) on Aircraft Availability and Procurement Costs.

CUSTOMER: HQ AFLC/XP

OBJECTIVES: Determine how changes in O&STs and DRCTs affect procurement costs and the resultant worldwide aircraft availability of all or selected weapon systems.

ANTICIPATED BENEFITS: More responsive resupply times can mean large savings in procurement costs for spares. This study will quantify the savings by comparing the procurement costs resulting from using the current resupply times with resupply times of 20, 40 and 60 days. We will also measure the impact on procurement costs of changing the transportation times included in the O&STs and DRCTs by one day.

ESTIMATED COMPLETION DATE: March 1990

PROJECT LEADER: Mr Fred Rexroad; Com (513) 257-6920; AV 787-6920

OTHER ANALYSTS: Capt Roger Moulder; Com (513) 257-6920; AV 787-6920

PROJECT OVERSEER: Mr Jack Hill; Com (513) 257-6920; AV 787-6920

D.4 **TITLE:** Alternative Strategies for Funding Maintenance Dollar Shortfalls.

CUSTOMER: AFLC/MMI

OBJECTIVE: Develop repair costs versus aircraft availability tables by weapon system by modifying the CREATE versions of the Aircraft Availability Procurement Model (AAPM) and the Aircraft Availability Assessment Model (AAAM).

ANTICIPATED BENEFITS: Provide MMI an improved procedure for allocating maintenance dollar shortfalls.

ESTIMATED COMPLETION DATE: April 1990

PROJECT LEADER: Capt Roger Moulder; Com (513) 257-6920
AV 787-6920

OTHER ANALYSTS: Mr Fred Rexroad; Com (513) 257-6920;
AV 787-6920
Mr Bill Morgan; Com (513) 257-6920;
AV 787-6920

PROJECT OVERSEER: Mr Jack Hill; Com (513) 257-6920;
AV 787-6920

D.5. **TITLE:** Support to the Requirements Data Bank (RDB) Development

CUSTOMER: AFLC/MMI

OBJECTIVE: The RDB objectives are to improve and modernize the AFLC logistics requirement management systems. In support of this effort, XPSC will provide technical direction and guidance in the design and development of the computational techniques to be utilized in the RDB.

ANTICIPATED BENEFITS: Improved allocation of resources; improved budget and POM forecasts; all requirements determined in accordance with approved end item readiness goals.

ESTIMATED COMPLETION DATE: This is a long term project extending into the mid nineties. This project basically covers XPSC personnel acting in a consultant capacity.

PROJECT LEADER: Mr Fred Rexroad; Com (513) 257-6920;
AV 787-6920

OTHER ANALYSTS: Capt Roger Moulder,
Mr Bill Morgan; Com (513) 257-6920;
AV 787-6920

PROJECT OVERSEER: Mr Jack Hill; Com (513) 257-6920;
AV 787-6920

D.6. **TITLE:** Support to the D028 Central Leveling System

CUSTOMER: AFLC/MMI

OBJECTIVES: Provide technical support for the running of the D028 Central Leveling System. Maintain D028 Historical Data Base.

Complete User's Manual for using XPSC developed programs for extracting data from the historical data base.

ANTICIPATED BENEFITS: Have a data base readily available for doing special studies and to do data analysis. Provide technical expertise for resolving D028 problems that may surface. Maintain a research version of D028 algorithms, on CREATE, for testing improvements to algorithms.

ESTIMATED COMPLETION DATE: December 1990

PROJECT LEADER: Mr Freddie Riggins; Com (513) 257-6920;
AV 787-6920

PROJECT OVERSEER: Mr Jack Hill; Com (513) 257-6920;
AV 787-6920

D.7. **TITLE:** An Analysis of the Depot Repair Cycle Times (DRCTs), Order & Ship Times (O&STs) and Base Repair Cycle Times (BRCTs) used in the D041 Requirements Computation for Aircraft Spares.

CUSTOMER: Internal

OBJECTIVES: (1) Measure how the DRCTs, O&STs, and BRCTs for individual National Stock Numbers (NSNs) vary over time. (2) Determine if there are significant differences in the DRCTS, O&STs, and BRCTs used for NSNs in a buy versus non-buy position. (3) Determine the number of DRCTS, O&STs, and BRCTS where standards are used, where estimates are made, and where they are computed from data.

ANTICIPATED BENEFITS: Knowledge gained from this study could result in a basis for compressing resupply times which would mean big savings in spares costs. This study will provide valuable insights into the variability of the pipeline times and how they are established.

ESTIMATED COMPLETION DATE: May 1990

PROJECT LEADER: Mr Fred Rexroad; Com (513) 257-6920;
AV 787-6920

OTHER ANALYSTS: Mr Bill Morgan; Com (513) 257-6920;
AV 787-6920

PROJECT OVERSEER: Mr Jack Hill; Com (513) 257-6920;
AV 787-6920

D.8. **TITLE:** Incorporate Engine Data into the Requirements Computation

CUSTOMER: Internal Study

OBJECTIVE: Validate the implementation strategy proposed in a study by a contractor to incorporate engine pipeline and stock level data into the D041 requirements computation. Develop an XPSC

prototype of the model the contractor used for its study. Expand the prototype model to include all engine types.

ANTICIPATED BENEFITS: Improved requirements computation for D041 recoverable components.

ESTIMATED COMPLETION DATE: December 1991

PROJECT LEADER: Capt Charles Porter; Com (513) 257-6920; AV 787-6920

PROJECT OVERSEER: Mr Jack Hill; Com (513) 257-6920; AV 787-6920

D.9. **TITLE:** The Aircraft Availability Maintenance Model (AAMM)

CUSTOMER: AFLC/MMI

OBJECTIVE: Develop, program, verify, and validate an AAMM to measure the impact of changes in the repair budget on aircraft availability.

ANTICIPATED BENEFITS: The AAMM will be a planning model that provides AFLC the capability to relate expenditures in repair dollars to available aircraft. It will be used to justify AFLC repair budgets by being able to demonstrate the impact of repair funding shortfalls on available aircraft. The AAMM will utilize data provided by the D041 requirements computation system and many of the concepts embodied in the D041 aircraft availability algorithms. It will produce tables relating repair dollars to the percentage of the fleet available. This information will be printed by weapon system for all weapon systems encompassing all BP1500 items. The tables will be produced for the apportionment year, the budget year, and the first year of the POM.

ESTIMATED COMPLETION DATE: December 1990

PROJECT LEADER: Capt Roger Moulder; Com (513) 257-6920; AV 787-6920

OTHER ANALYSTS: Mr Freddie Riggins; Com (513) 257-6920; AV 787-6920

PROJECT OVERSEER: Mr Jack Hill; Com (513) 257-6920; AV 787-6920

D.10. **TITLE:** Aircraft Availability and Weapon System Phase In/Out Study

CUSTOMER: Internal Study

OBJECTIVE: Test proposed procedure for improving the handling of weapon systems phasing in and out in the aircraft availability requirements computation.

ANTICIPATED BENEFITS: Improved requirements computation for D041 recoverable components.

ESTIMATED COMPLETION DATE: December 1991

PROJECT LEADER: Capt Charles Porter; Com (513) 257-6920;
AV 787-6920

PROJECT OVERSEER: Mr Jack Hill; Com (513) 257-6920;
AV 787-6920

JOHN M. HILL
Chief, Concept Development Division
DCS/Plans and Programs

IV. THE CONSULTANT SERVICES DIVISION

A. INTRODUCTION

The Consultant Services Division, XPSM, contributes in three functional areas: conducting studies, developing and using computer models, and providing consulting support to the staff.

In our studies role, we conduct studies and assist other AFLC staff agencies in improving logistics policies and procedures. We also assist other agencies and staff offices in assessing logistics readiness, particularly in relating aircraft engine management decisions to aircraft readiness in both peace and war.

In doing the study and study support tasks, we often find it necessary to use computer models to describe relationships and constraints within the logistics processes and to forecast what is likely to happen in the future or under different circumstances.

The Division develops and uses models such as JEMS (Jet Engine Management Simulator), OMENS (Opportunistic Maintenance Engine Simulator), Air Freight Terminal Simulation models, F100 Depot Repair Model, the JEIM Engine Flow Days Model, and the Propulsion Decision Support System. These models support simulations and analyses in many project areas for various staff elements.

In our consulting role, we assist other staff offices and agencies in using models and mathematical and statistical techniques on a wide variety of topics and short term tasks. Much of this is done informally by phone or in meetings.

We have a staff of six analysts and one reservist, most of whom have advanced degrees in technical areas such as mathematics or engineering. Each analyst tends to specialize in some major area of logistics management.

B. ACCOMPLISHMENTS IN 1989

During 1989 we placed particular emphasis on the areas of aircraft engine management and overall data base development/improvement, particularly for the Engine Pipeline Products in the Comprehensive Engine Management Systems (CEMS), D042. During 1989 we completed projects on the Wartime Data Bases, and Cargo Sorting and Handling Simulation. We provided personnel to assist The Concept Development Division with the Reliability & Maintainability and the Demand Forecasting Projects. We also provided personnel for the CORONET WARRIOR III exercise at England AFB. We began two new projects. These are SWAP (Spares Wartime Assessment Procedure) and Projecting Manpower for Weapon Systems. In addition, we provided assistance to DSXE in its Intra Depot Transportation System (IDTS) project, to XPS in the Two-Level Maintenance Study, and to XPR in a Dual Sourcing Project.

B.1. **TITLE:** Engine Pipeline Analysis

CUSTOMER: LOC/PNA

OBJECTIVES: To participate with the Engine Systems Management Division, LOC/PNA, in jointly assessing the current reporting and management of aircraft engine pipelines, and to assist in developing improvements by providing statistical and computer modeling capability and operations research expertise. The major tasks were:

(1) To identify deficiencies in the current D042D Engine Pipeline Reports, and to develop, prototype, and recommend changes that would improve engine management of pipelines;

(2) To develop consistent criteria and methodology for establishing peacetime pipeline standards for aircraft engine management; and

(3) To develop methodology for establishing wartime pipeline standards based on peacetime baselines.

RESULTS: This is a multi-task project and results are listed below by major task area:

(1) Data Base. A pipeline data base with about a million records derived from D042D (Comprehensive Engine Management System, CEMS) was established for a selected number of aircraft engines on the CREATE computer. The data base was analyzed and used as a test bed for developing methodologies for setting pipeline standards. Using the data base, problems with current CEMS pipeline reporting were identified for correction and assistance was given to the customer in refining/redefining the definitions of all the engine pipeline cycles and segments.

(2) Standards Methodology. Pipeline time means, standard deviations, frequency distributions, networks, and displays were developed from the CEMS data base to gain knowledge about actual pipeline times and to assist in developing a methodology for computing pipeline standards. The methodology developed for peacetime standards was reviewed by the MAJCOMs. In addition, it was service tested by providing computations of proposed peacetime pipeline standards for consideration and approval by the Engine Review Organizations for the F100-220 and F110-100 engines and modules using the most recent CEMS data.

(3) Base Repair Flow Times. Models and prototype computations were developed to help predict pipeline flow times for complex maintenance facilities at both base level and depot level. For base repair, a regression analysis was conducted to develop an equation involving several key variables to provide forecasts of expected pipeline times. This capability would be useful for predicting flow times for changing conditions and to allow adjustment of standards and experience data for individual differences between bases, commands, etc. Results were inconclusive,

however, so two models were developed to do these tasks, a base level model and a depot level model. The Base Repair Flow Time Model was developed to predict in-work flow times as functions of the current peacetime experience, and anticipated resources such as manning, shift lengths, number of shifts per day, efficiency factors, stands, etc. A K-factor technique was developed to simplify the computation involving all these factors. In addition, development of an analytic model was begun to predict Awaiting Maintenance Time for a constrained repair facility. This formula may be accurate enough for some applications, and is being considered for both stand-alone use and for inclusion in the Base Flow Time Model. The Base Flow Time Model can run in the personal computer (PC) environment, or on the main frame CREATE computer, depending upon complexity and the amount of accuracy desired. Work on these capabilities will continue into CY 90.

(4) A Depot Repair Model was developed to predict flow times for depot repair. This model was also used to investigate the relationship between sub-assembly floating stock and major assembly (such as an engine or a module) repair flow times. We are currently working with HQ AFLC/MAP to test out the floating stock computation for several engine modules. The floating stock study will be continued into CY 90.

(5) A Pipeline Decision Support System is being prototyped on a Z-248 PC to provide the pipeline manager/analyst with guidance, formulae, models, and data to analyze pipeline experience data and to perform computations of both peacetime and wartime pipeline standards. The prototype interfaces with CEMS through a work file and is supplemented manually from other data bases, allowing the user to assess past pipeline standards and to develop and establish new ones for both wartime and peacetime. The prototype is a menu-driven system that provides the user with accepted ways of computing standards or analyzing historical data. It also serves as a prompter, suggesting computations and displays that the user might use. This work will continue into CY 90.

(6) CEMS Specifications. Assistance was provided to LOC/PNA in developing specifications for enhancements to the CEMS system to incorporate the pipeline improvements described above and for revisions to management manuals and regulations required to implement the improvements. This tasking will continue into CY 90.

ANALYSTS: Mr John Madden,
Mr Harold Hixson,
Mr Phil Persensky,
Mr Bill Morgan,
Mr Tom Stafford; Com (513) 257-7408, AV 787-7408

B.2. **TITLE:** Wartime Data Bases

CUSTOMER: AFLC/MMM

OBJECTIVE: To determine whether there is a difference in

failure rates between war zone and non-war zone flying activity. In this project we reviewed, assessed, and exercised two war data bases to determine their usefulness in developing wartime factors for requirements and planning purposes. The data bases are the USAF Southeast Asia (SEA) data covering the Vietnam era, and a classified foreign data base covering selected weapons and time periods.

RESULTS: There was no activity with the SEA data base. The foreign data base was updated with the latest available data provided by AFHRL. An analysis was done to assess the wartime impacts on failure rates and the results were presented to MMM, LOC/PNA, LOC/TL, and AFHRL. The analysis was updated using sorties in lieu of flying hours. Assistance was provided to MMM personnel in their study of Air Battle Damage Repair. We participated in the Combat Data Base Users Group meeting and the final review of the contract for the Combat Data Base development conducted by AFHRL. The Combat Data Base release agreement, prepared by AFHRL, was reviewed, coordinated with MM, and signed. Our disk files, documentation, and reports were marked as permanent documents for storage as classified material. Our data base remains available for local HQ AFLC access. Additional data requirements will now be processed through SURVIAC. No further actions are planned for this project.

ANALYSTS: Don Casey,
Bill Morgan,
Major John H. Evans III; Com (513) 257-7408
AV 787-7408

B.3. **TITLE:** Jet Engine Management Simulator (JEMS) Applications

CUSTOMERS: AFLC/MMMR, LOC/PNA, ALCs, MAJCOMs

OBJECTIVE: To use the TJEMS or MJEMS models to answer specific questions relating aircraft readiness to engine support.

RESULTS: Assistance was given to the Air Force Audit Agency (AFAA) in recalling previous work we had done to support AFAA studies of the C-5A engines using the JEMS model. We provided AFAA information about runs we had helped it make in late 1985 and early 1986 and runs we had helped HQ MAC with in late 1986. In addition, logic from the JEMS model was used as the basis for developing part of the Base JEIM Flow Days Model reported under B.1 above.

ANALYSTS: Harold Hixson,
Phil Persensky; Com (513) 257-7408; AV 787-7408

B.4. **TITLE:** Opportunistic Maintenance Engine Simulator (OMENS)

CUSTOMER: AFLC/MMMR, ASD/YZL, OC-ALC/MM, SA-ALC/MM

OBJECTIVE: To assist the acquisition community in formulating optimal decision rules to determine which engine life limited parts

should be replaced at the time of aircraft engine maintenance. The OMENS model is applied to different engines through specific computer program modifications to estimate engine factors for requirements computations. It is also applied to engines still in the acquisition cycle. We assisted users by helping them to modify and apply the OMENS model.

RESULTS: Assistance was provided to ASD/YZL and its contractor, Management Consultants & Research, in reprogramming OMENS for use on a Z-248 PC. We also briefed the International Logistics Committee on the model. We also provided assistance to the Air Force Audit Agency in determining how it might use OMENS in its study of the impact of manufacturers' estimates of engine Unscheduled Removal Rate factors on requirements for engine and module spares. We showed AFAA how to use the OMENS and MOD-METRIC models in tandem to accomplish its objective.

ANALYSTS: Tom Stafford,
Bill Morgan; Com (513) 257-7408; AV 787-7408

B.5. **TITLE:** Cargo Sorting and Handling Simulation

CUSTOMER: AFLC/DSXE

OBJECTIVE: To assist DSXE in adapting/applying models of the LOGAIR cargo sorting and handling processes in Air Freight Terminal areas. The models are CAPTENS (Cargo Assessment and Prediction of Terminal Equipment Needs by Simulation) and CREW (Computation of Required Equipment and Workload).

RESULTS: Interface programs to transfer data back and forth between CAPTENS and CREW were finalized. Final documentation, including an Executive Summary, was completed.

ANALYSTS: Harold Hixson,
Tom Stafford; Com (513) 257-7408; AV 787-7408

B.6. **TITLE:** Spares Wartime Assessment Procedure (SWAP)

CUSTOMER: AFLC/XP

OBJECTIVES: To learn the features of USAF's SWAP model which relates sorties to budgets, to get the model running on AFLC computers, to develop improved output, and to assist the Headquarters AFLC staff in running and maintaining the model.

RESULTS: We received the model and documentation from USAF/LEXY and established a working relationship with it and with its contractor, SYNERGY, Inc., (SYNERGY maintains and runs the model). We developed a user interface that enables one to interactively run the model on a Z-248 PC. We have developed a study plan, and developed a briefing to explain the model's capabilities and to define roles. We are ready to brief the functional organizations. We also assisted the Logistics Operations Center in

using the model to develop a war requirement input to HQ MAC. This project will continue into CY 90.

ANALYSTS: John Madden, XPSM, (Project Overseer)
Bob McCormick, XPSA, (Devil's Advocate)
Capt Roger Moulder, XPSC, (Team Leader)
Rich Moore, XPSA, (Team Member);
Com (513) 257-7408; AV 787-7408

B.7. **TITLE:** Projecting Manpower for Weapon Systems.

CUSTOMER: AFLC/XP

OBJECTIVES: To look into the Mission Assignment Process used by XP for new weapon systems and to develop a method to forecast depot O&M manpower requirements by ALC for new weapon systems.

RESULTS: This was a short term project requested by Gen Curtis, AFLC/XP. All available, known methods used by AFLC, AFSC, and elsewhere were researched. In addition a regression study was developed using CY 1988 data and tested using OC-ALC data for CY 1986. The literature search and the regression study were briefed to the XPS Technical Review Board and to Gen Curtis. A briefing was made to the Analyst's Conference at ALD. A study plan was developed for follow-on work and coordinated with XPR and XPM. A report is in the final stages of development. This project will extend into CY 1990 until the report is finalized and released and the follow-on work is accomplished.

ANALYSTS: Vic Presutti, XPS (Project Overseer)
Capt Roger Moulder, XPSC (Devil's Advocate)
Tom Stafford, XPSM, (Team Member)
Don Casey, XPSM, (Team Member)
Bill Morgan, XPSM, (Team Member)
Bob McCormick, XPSA, (Team Member)
Com (513) 257-7408; AV 787-7408

C. **OTHER DIVISION ACTIVITIES**

We supported a reservist, Maj John H. Evans III, who is assigned to XPSM for training as an Individual Mobilization Augmentee.

We assisted various AFIT graduate students in using our data/models/ other talents.

We are the Air Force experts on both the Jet Engine Management Simulator (JEMS) and Opportunistic Maintenance Engine Simulator (OMENS) and assist the ALCs, the MAJCOMs, and others in applying them to various aircraft engine studies.

One of our senior analysts is an Adjunct Professor at the Air Force Institute of Technology's School of Systems and Logistics (AFIT/LS). We provide guest speakers every quarter to AFIT/LS courses and we

sponsor the course, LOG 221, Logistics Managers and Computer Simulation.

D. THE PROGRAM FOR 1990

During 1990 and beyond we expect to continue to support the staff and our other customers with projects and consulting services. We will place particular emphasis on the areas of aircraft engine management and overall data base development/improvement, particularly for the Engine Pipeline Products in the Comprehensive Engine Management Systems (CEMS), D042. The following projects reflect our current priority order.

D.1. TITLE: Engine Pipeline Analysis

CUSTOMER: LOC/PNA

OBJECTIVES: To participate with the Engine Systems Management Division, LOC/PNA, in jointly identifying and developing improvements in the current reporting and management of aircraft engine pipelines by providing statistical and computer modeling capability and operations research expertise. The major tasks are:

(1) To continue to develop, prototype, and recommend changes in D042D Engine Pipeline Reporting and Processing that will improve management of engine pipelines;

(2) To continue to develop consistent criteria and methodology for establishing and maintaining peacetime and wartime pipeline time standards for aircraft engine management; and

(3) To continue to develop and implement the Propulsion Pipeline Decision Support System (PDSS).

ANTICIPATED BENEFITS: Maintaining visibility and control over engine assets in all segments of the resupply pipeline is vital to providing and maintaining high aircraft availability rates and in keeping requirements for expensive aircraft engines and modules at the lowest possible levels. This project will directly address the areas of data reporting and analysis, computing pipeline standards, and identifying the best management actions to take to correct for certain identified deficiencies.

ESTIMATED COMPLETION DATE: Dec 90

PROJECT OVERSEER: Mr John Madden; Com (513) 257-7408; AV 787-7408

TEAM LEADER: Mr Tom Stafford; Com (513) 257-7408; AV 787-7408

TEAM MEMBERS: Mr Harold Hixson,
Mr Phil Persensky,
Mr Don Casey; Com (513) 257-7408; AV 787-7408

D.2. **TITLE:** Floating Stock Methods

CUSTOMERS: AFLC/MAP, MMI, LOC/PNA

OBJECTIVE: To assist the customers in developing and implementing improved methods for computing floating stocks for depot repair of aircraft engines and modules.

ANTICIPATED BENEFITS: Reducing the number of major assemblies (engines or modules) and subassemblies that are tied up in the depot maintenance facility would allow lower support costs and/or higher weapon system readiness. Preliminary studies have shown that several more serviceable engines and/or modules can be made available for distribution to bases merely by providing floating stocks of modules/subassemblies. This can be achieved by using simulation modeling methods to set floating stocks and depot flow times.

COMPLETION DATE: December 1990

PROJECT OVERSEER: Mr John Madden; Com (513) 257-7408; AV 787-6920

TEAM LEADER: Mr Tom Stafford; Com (513) 257-7408; AV 787-7408

TEAM MEMBER: Mr Harold Hixson; Com (513) 257-7408; AV 787-7408

D.3. **TITLE:** AFLC Indicators

CUSTOMER: AFLC/XP

OBJECTIVES: The Command Information Digest (CID) is published quarterly and contains numerous statistics and ten year trends of assorted AFLC operations. Many of these statistics are presented as historical data and are poorly understood and/or not analyzed. This project will concentrate on identifying a small number of meaningful indicators which reflect the "health" of AFLC. These indicators will include inputs to AFLC (manpower, funds, equipment) and outputs to the customer (shipments, aircraft, engine and exchangeable repair, and aircraft fully mission capable).

The major tasks are:

(1) Determine how MM, MA, DS and PM evaluate the effectiveness of their operations.
(2) Select a few meaningful indicators for AFLC
(3) Establish goals and criteria to evaluate improvement or degradation in an indicator so we know what the statistics are telling us.

ANTICIPATED BENEFITS: Provide a manageable number of management indicators that are easily understood and reflect the

health of AFLC. This will provide a better source of management within the command and less chance of misinterpretation outside the command.

ESTIMATED COMPLETION DATE: To be determined. (This is a new project still in the planning stage.)

PROJECT OVERSEER: Mr Vic Presutti

TEAM LEADER: Mr Don Casey

TEAM MEMBERS: Mr Bill Morgan,
Mr Fred Rexroad; Com (513) 257-6920;
AV 257-6920

D.4. **TITLE:** Maintain and Apply Models.

CUSTOMERS: AFLC/MAP, DSXE, MMI, LOC/PNA, ASD/YZL, ALCs, MAJCOMs

OBJECTIVE: To maintain models that we have developed and to assist potential users in applying them in studying/improving/resolving USAF issues. The models include:

(1) Jet Engine Management Simulator (JEMS)
(2) Opportunistic Maintenance Engine Simulator (OMENS)
(3) Cargo Assessment and Prediction of Terminal Equipment Needs by Simulation (CAPTENS)
(4) Computation of Required Equipment and Workload (CREW)
(5) JEIM (Jet Engine Intermediate Maintenance) Flow Days Simulation Model
(6) Depot Repair Model
(7) Pipeline Decision Support System (PDSS)

ANTICIPATED BENEFITS: Anticipated benefits by model are:

(1) JEMS. Allows the user to answer a variety of readiness assessment type questions relating to adequacy of engine support and repair capabilities in both peace and wartime scenarios.

(2) OMENS. Substantial reductions in spare engine and module requirements are achieved because of improved factors produced by the optimal policies devised through the use of this model.

(3) CAPTENS. This model helps industrial engineers assess Mechanized Materials Handling System adequacy at AFLC Air Freight Terminals.

(4) CREW. This model helps industrial engineers assess and select Mechanized Materials Handling Systems for use in AFLC Air Freight Terminals.

(5) JEIM Flow Days Model. This model helps pipeline managers determine/assess JEIM standard pipeline times.

(6) Depot Repair Model. This model helps pipeline managers determine/assess depot repair flow times. It also helps maintenance managers determine/assess floating stock and related higher assembly flow days in repair.

(7) PDSS. This model helps AFLC and MAJCOM users select and use a variety of approved computational methods in an interactive PC environment, to assess/ recompute/ compare engine and module pipeline times and standards.

ESTIMATED COMPLETION DATE: Continuing

PROJECT OVERSEER: Mr John Madden; Com (513) 257-7408; AV 787-7408

TEAM LEADER: Mr Tom Stafford; Com (513) 257-7408; AV 787-7408

TEAM MEMBERS: Mr Harold Hixson
Mr Phil Persensky; Com (513) 257-7408, AV 787-7408

D.5. **TITLE:** Intra-Depot Transportation System (IDTS)

CUSTOMER: AFLC/DSXE

OBJECTIVE: To assist the customer in developing and implementing simulation models of potential on-base automated distribution systems (conveyors, monorails, pneumatic tubes, etc.) using the AUTOMOD II system on a Silicon-Graphics Workstation.

ANTICIPATED BENEFITS: The IDTS is a major initiative ($75 million program) to design and implement new or expanded material transport systems based on prior simulation of systems at each ALC using data currently being collected. The simulation models are expected to help avoid design defects and to help concentrate investment on those systems indicated by simulation results to be clearly superior to competing systems.

COMPLETION DATE: Dec 90

PROJECT OVERSEER: Mr John Madden; Com (513) 257-7408; AV 787-7408

PROJECT LEADER: Mr Harold Hixson; Com (513) 257-7408; AV 787-7408

D.6. **TITLE:** Spares Wartime Assessment Procedure (SWAP)

CUSTOMER: AFLC/XP

OBJECTIVES: To understand the strengths and weaknesses of SWAP and to determine if it can be used by AFLC to shed light on the readiness and sustainability implications of various budgeting strategies.

ANTICIPATED BENEFITS: Since USAF/LEX uses this model in the budgeting process, the credibility of the model is already established. This model may give AFLC the ability to quickly

analyze the impacts of various budgeting strategies on wartime capability.

ESTIMATED COMPLETION DATE: Continuing.

PROJECT OVERSEER: Mr John Madden, Com (513) 257-7408;
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PROJECT LEADER: Capt Roger Moulder, Com (513)257-7408;
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